DRAFT Appendix C-WRD 10.06

Hazard Analysis Guidelines for Risk Factors 5-6, High Hand Force

Department of Labor and Industries
WISHA Services Division

This document will assist inspectors in reviewing work sites where caution zone jobs have been identified. The inspector does not have to evaluate every job, but can use the following strategy for representative sampling. Inspectors will use Appendix B of the rule (WAC 296-62-05174) to evaluate whether there are hazard zone jobs. However, the employer has the option to use an analysis tool other than Appendix B. Some acceptable methods of alternate analysis are identified with each risk factor; in cases where the employer is relying upon either a listed alternative or another alternative, the inspector will need to request that an ergonomist assist them in these inspections.

This appendix contains the following sections to assist inspectors in making their determinations:

- Typical clues to recognize the High Hand Force
- Typical jobs where the hazard zone job risk factors for High Hand Force are found.
- Tips on measuring High Hand Force
- Acceptable methods of hazard analysis when using the general approach
- Typical solutions chart
- Common questions for High Hand Force

The caution zone criteria for High Hand Force are:

- Pinching an object weighing more than 2 pounds per hand for more than 2 hours total per workday.
- Gripping an object weighing more than 6 pounds per hand for more than 2 hours total per workday.

The hazard zone criteria for High Hand Force risk factors per Appendix B (WAC 296-62-05174) are:

- Arms, wrists, hands-**pinching** an unsupported object weighing 2 or more pounds per hand, or with a force of 4 or more pounds per hand (comparable to pinching 1/2 a ream of paper):
    - Highly repetitive motion-more than 3 hours total per day
    - Wrists bent in flexion 30 degrees or more, or in extension 45 degrees or more, or in ulnar deviation 30 degrees or more-more than 3 hours total per day.
    - No other risk factors-more than 4 hours total per day.

- Arms, wrists, hands-**gripping** an unsupported object weighing 10 or more pounds per hand, or with a force of 10 pounds or more per hand. (comparable to clamping light duty automotive jumper cables onto a battery)
    - Highly repetitive motion-more than 3 hours total per day
    - Wrists bent in flexion 30 degrees or more, or in extension 45 degrees or more, or in ulnar deviation 30 degrees or more-more than 3 hours total per day.
    - No other risk factors-more than 4 hours total per day

Typical clues to recognize the risk factor: High Hand Force

- Look for hand intensive work. Gripping and pinching are very common motions, but need to be evaluated to see if they reach the duration and force levels necessary to be covered by the rule.
- Jobs where the hand is used as a clamp are likely to reach the duration requirement for High Hand Force.
- Workers who frequently carry boxes, bags, or other loads for any significant distance are also likely to reach the duration requirement.
- Some jobs may appear to require little force, but actually require more of a grip than is readily apparent. Grip force is typically increased when handling slippery objects, or when working in the cold or using loose fitting gloves, both of which reduce sensation and result in over-gripping.

Typical clues to recognize the risk factor: Pinching

- Pinching involves holding objects with the tips or sides of the fingers, and the tip of the thumb. Sometimes either the fingers or thumb will be used to grip against the palm of the hand, and this would be a pinch grip as well. Usually at least one knuckle on each of the fingers will be straight, and the thumb is almost always straight at the second knuckle.
- A pinch grip is typically used when handling small tools, flat objects such as sheet metal and paper, or small containers with flat sides and open tops when gripped from the top.

Typical clues to recognize the risk factor: Gripping

- Gripping involves a grasp with the whole hand, where the fingers and thumb wrap around object, look for curled fingers or a "fist shaped" hand.
- Typically only small, rounded objects or objects with handles can be gripped using a power grip. Boxes are typically lifted from underneath using a hook grip with the fingers, and some heavy, flat objects such as plywood are lifted from above or the side with the fingers pressing the object into the palm. Treat both of these as gripping, rather than pinching, since these grips tend to use the stronger muscles of the forearm.
- Visual cues for effort include tendons standing out in wrist, muscles in forearm active, especially near the elbow.
- Some tasks may seem to involve hand force but really do not - an example might be working with tools that require downward pressure on a flat, horizontal surface where the weight of the tool actually helps to do the work so it does not have to be gripped tightly.
- Pushing a cart does not require a tight grip on the handle, although often pulling it will.
- Workers who use hand tools, large power tools, or do any type of shoveling will typically use high hand forces

Typical jobs where High Hand Force CZJ/HZJ risk factors are often found:

Risk Factors	Typical Jobs
Pinching	• Sheet metal work in a machine shop • Lifting plywood or drywall in construction • Lumber grader turning boards in a sawmill • Using small hand tools in electronics assembly • Sewing heavy fabric garments • Moving large stacks of paper in a print shop • Shelving books in a library
Gripping	• Mechanics • Maintenance workers • Construction workers • Landscapers • Warehouse workers • Furniture movers

Tips on measuring the risk factor High Hand Force:

- Evaluate gripping and pinching as separate risk factors. In other words, 1 hr. of gripping 10+ lbs. and 1 hr. of pinching 2+ lbs. do not add up to a "caution zone job" of 2 hrs. of high hand force.
  - Exception - in Appendix B of the rule (WAC 296-62-05174) hazard analysis when high hand force is combined with highly repetitive motion and awkward wrist posture. Here inspectors can count either of the two types of high hand force towards the 2-hr. duration limit. See the Combined Risk Factors section for more information.)
- The duration of exposure for high hand force is the actual time that force is being applied, i.e., the actual time the object is being held or squeezed. This can be determined through representative sampling of typical job tasks. Also, see the special notes for hand force combined with highly repetitive motion, awkward wrist posture, or both under the Combined Risk Factors section.

The simplest method is to weigh the object. Inspectors can also use other sources such as manufacturer's technical specifications or labeled box weight.

- **(Pinching)** The object pinched weighs > 2 lbs. (pinched using one hand) or > 4 lbs. (pinched using two hands).
- **(Gripping)** The object gripped (tool, box, etc.) weighs > 10 lbs. (held using one hand), or > 20 lbs. (held using both hands).

When trying to determine how squeeze force is being used, where object weight is not the issue, it is best to use a comparison method. First, have the employee perform the task a few times using typical grip or pinch force.

- **(Gripping)** Next, have the employee compare that force with squeezing a light-duty automotive jumper cable clamp (equivalent to 10 lbs. of grip force).
- **(Pinching)** Next, have the employee compare that force with holding a half-ream of paper from above in a pinch grip.

The goal of this method is to have the employee compare the task requirements with a known standard and make a less or more determination. How much more or less is not a concern, only the relative force required. Repeat the comparison as many times as is necessary for the employee to be certain of his or her response. Where several workers do the same task, have a number of the employees do the comparison test to determine if individual differences account for the amount of force being used.

Acceptable methods of hazard analysis for High Hand Force risk factors (acknowledged by the general approach allowed within the rule):

- Job Strain Index
- ACGIH Hand Activity Level (HAL) Threshold Limit Value (TLV)
- UAW-GM Risk Factor Checklist

It is acceptable for an employer to have used any of these methods to assess high hand force for the job in question. Inspectors will need to ask for the results of the assessments. Contact the ergonomists at Policy & Technical Services for assistance. Inspectors do not need to know how to do these assessments nor how to interpret them.

Typical Solutions Chart for High Hand Force:

Risk Factor	Typical Solution
Pinching	Grip objects from underneath
	Attach lift handles e.g., suction cup handles, magnetic handles, to smaller objects
	Use lift devices, e.g., lift magnets, vacuum lifts, sheet lifters, for larger objects
	Place objects on carts, hand trucks, conveyors to transport rather than carrying
	Use air tables to float flat objects across surfaces
Gripping	Lighter tools
	Tool counterbalances
	Longer lever arms on tools
	Hand trucks, carts or conveyors instead of carrying loads
	Power tools instead of hand tools - may not reduce force but can reduce duration

Commonly asked questions for High Hand Force:

(1) Does holding onto a truck steering wheel involve high hand forces?

Under normal operation, holding a truck steering wheel should not involve high hand forces. The weight of the object does not determine whether the job is a high hand force job unless it is being held against gravity. What matters is how hard the steering wheel is gripped. The grip required to turn a truck may require high hand force, although it is unlikely that the total duration of turning the steering wheel under normal operation would be long enough to qualify as a "caution zone job", much less a hazard. If there is some question about forces required, employers should ask drivers to compare the hand forces used on the steering wheel with the force required to open a jumper cable clamp. Factors that could increase the amount of hand force used on a steering wheel include excessive vibration, faulty alignment so that the truck pulls in one direction, or excessive play in the steering requiring frequent steering corrections.